JULY 11, 1983

CHEMICAL & ENGINEERING

NEWS

FINAL PROGRAM
ACS Washington, D.C., meeting
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Linus Pauling wins 1984 Priestley Medal

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CHEMICAL & ENGINEERING NEWS

JULY 11, 1983

News of the Week

■ **Two developments concerning agent orange—release of evidence in suit against producers and of an Air Force mortality study—add to understanding of dioxin danger.** **Page 4**

■ **Study on the health effects of exposure to chemicals in hazardous waste sites is planned by Chemical Manufacturers Association.** **Page 5**

■ **Newly approved use by FDA of low-calorie sweetener aspartame in carbonated diet soft drinks raises cost questions.** **Page 5**

Business

Lime, sulfur, potash, and phosphorus hurt by low demand for use in fertilizer, steel, and detergent markets. **Page 7**

Government

Legislative veto, ruled as unconstitutional, could affect the chemical industry through such laws as Superfund. **Page 13**

Science

Dioxin's health risk being examined by EPA, other groups; EPA's dioxin research budget nearly triples. **Page 16**

Science Policy

U.S. role in industrial science and technology policy is under scrutiny in study by the American Enterprise Institute. **Page 21**

Final Program

The 1983 ACS annual meeting in Washington, D.C., boasts 516 technical sessions, features a variety of social activities, special events, and awards. **Page 28**

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Priestley Medal

Linus Pauling, man of controversy and distinction, discusses his interest in molecular structure, contributions to chemistry, and penchant for new ideas. **Page 18**

Mineral-Based Inorganics Languish in Continuing Recession

It's still tough times for lime, sulfur, potash, and phosphorus because demand continues low in fertilizer, steel, and detergent markets

Bruce F. Greek, C&EN Houston
William F. Fallwell, C&EN Washington

The major U.S. mineral-based inorganics, such as the four covered here—lime, sulfur, potash, and phosphorus—seemed to bob up in the late 1970s and show new life after earlier shocks. But the 1980s have been rough sledding. Even though they are not hydrocarbon-based and thus somewhat buffered from the world oil price, these materials are in deep trouble.

It isn't just that these products have been caught in the recession and are slow in recovering. That's certainly true and explains much of the combined 20% tonnage drop last year. However, there are deeper market fissures that will remain even if these inorganics get some lift from the general economic recovery.

Part of the underlying problem is that these inorganics are textbook commodities. Three of them—lime, sulfur, and potash—are ultracheap, low-value-added materials going to highly mundane uses wide open to competition worldwide. As many other commodity chemical producers have found out lately, that's a very dangerous position for old products in an industrialized economy. Phosphorus is notably higher priced but still suffers from many of the same commodity blues.

As a result, all of the traditional U.S. sources of these chemicals are slowly losing out to newer developments, many hinging on international trade. Take lime, with the largest volume of the four and one of the highest-tonnage products of the entire chemical industry. Although foreign trade in lime itself is miniscule, trade has hurt its major outlet in steel horribly.

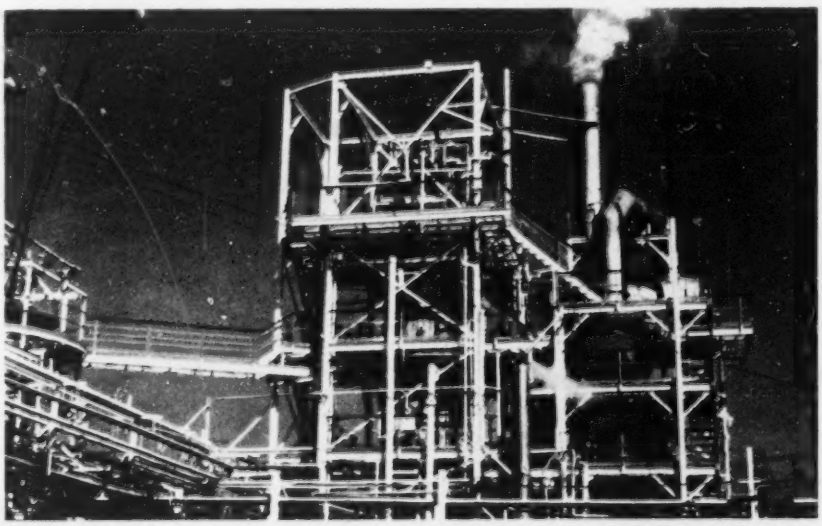
Then in sulfur, conventional mined (Frasch-process) production is essentially priced out of the market by newer by-product sources stemming from pollution control installations at oil refineries, natural gas processing plants, and metals smelters. As yet, there isn't enough by-product capacity to wipe out Frasch production, but Frasch output is definitely the swing part of supply and goes up and down dramatically with economic cycles. Here, too, imports of by-product sulfur are now a major part of supply.

Key Chemicals

For potash, Canadian imports are the crucial problem and have pushed down U.S. production by half over the past two decades. Although U.S. potash steadied itself in the late 1970s and had some good years, it is sinking fast at the moment. U.S. potash capacity is down about one fourth from three years ago, exports have dropped in half, and output is off one third. The crowning blow has come from the U.S. government, whose payment-in-kind (PIK) program to reduce planted acreage has crimped most agricultural chemicals this year.

Phosphorus is a much higher-value product than the other three—its total production value, for example, is more than three times that of potash and 125% of that of lime, even though phosphorus tonnage is a small fraction of the other two. That still doesn't save phosphorus from competition. As competing wet-process phosphoric acid is made in purer grades, one after another of elemental phosphorus markets is threatened.

For details on the sobering immediate market prospects for these chemicals, see the following pages.



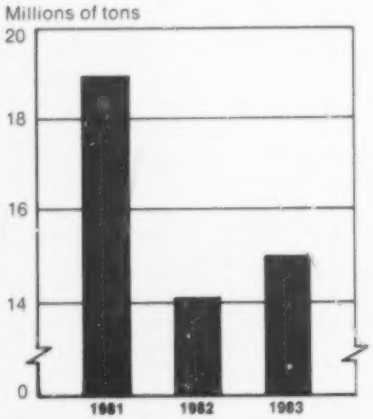
Furnace at FMC's Carteret, N.J., plant converts phosphorus to phosphoric acid

Lime

CaO

- ***Limited demand recovery***
- ***Capacity too large***
- ***Pricing still weak***

PRODUCTION



Note: No capacity estimates are available.

HOW MADE

Calcining limestone (mainly $CaCO_3$) make quicklime (CaO), then adding water to make hydrated lime ($Ca(OH)_2$)

MAJOR END USES (U.S.)

Metallurgy (mainly steel flux) 40%, chemicals 10%, potable water treatment 10%, sewage and pollution control 10%, construction 5%

FOREIGN TRADE

Exports—about 25,000 tons in 1983, imports—flat at about 350,000 tons

PRICES

$30 to $50 per ton, depending on type; discounts still significant

COMMERCIAL VALUE

$550 million for production, 1983

Lime, the fifth-largest-volume chemical produced in the U.S., faces a long road back after an extraordinarily rough trip through the past three recessionary years. Normally a slow-moving product with a 20-year history of steady rise and then plateau, lime was smashed three years straight for a net 33% production drop after its recent high point of 21.0 million tons in 1979. Last year alone, lime output fell 25% to 14.1 million tons.

Recovery from this disastrous period has just begun, considerably behind recovery of many other chemicals, some of which use lime in their manufacture. In first-quarter 1983, lime production apparently still declined, about 10% from first-quarter 1982.

However, for all of 1983, lime production likely will rise 5% or more. Steel making, the largest use for lime, has been rising from its extreme low point late last year and appears to be pulling lime up with it.

If steel demand doesn't falter, if most of the other shell-shocked uses of lime recover, and if lime's lone rising use in stack gas scrubbing keeps going, lime production could exceed 15 million tons in 1983, up 7%.

There is some seasonality in lime demand, with more consumed in the second half of the year than in the first. The reasons include variations in steel demand related to shifts in automobile production and vagaries in small uses such as sugar beet processing. In 1982, such seasonality didn't appear, mainly because of steel's abysmal fourth quarter, when operating rates plunged to 30 to 35% of capacity.

Estimates of total lime use in metallurgy last year fell to about 4.8 million tons, down a whopping 39% from 7.9 million tons in 1981. Steel accounts for more than three fourths of this market, whose share of total lime use sank to just 34% in 1982, down from 42% in 1981. Assuming continued, although slowing, improvement in steel operations, combined with some gains in copper use, the metallurgical outlet could rise again to nearly 40% of lime use this year.

The shift over the past two decades to basic oxygen and electric furnaces for making steel caused a large overall increase in lime consumption until this recent economic downturn. However, this shift away from old open-hearth furnaces has been just about completed. Some lime makers can't expect more penetration growth in that use and will have to follow steel demand more directly. One slight advantage for lime is that, in periods of slow demand, the newer, lime-using furnaces are run preferentially. Still, lime could suffer if steel imports continue their rapid inroads.

In 1982, the only major use of lime that increased was stack gas scrubbing for pollution control. That use reached more than 1 million tons, or 7% of production. In 1983, the scrubbing outlet likely will post another record, probably up more than 10%, according to industry analysts. This area likely will continue to grow fairly fast as more scrubbers are installed, especially on industrial boiler stacks, which are now quite a small market compared to electric power plants. The power plant use could jump again if the current wave of reports on the acid rain controversy produces Congressional action.

The other major end uses of lime declined in 1982. They all seem likely to turn around in 1983, but many may not recover to 1981 levels. For example, construction uses, spurred by soil stabilization needs, could show one of the better gains this year as monies from the increased federal gasoline tax start pouring into highway construction and repair.

No significant changes in swollen lime capacity will occur in 1983. Many lime plants have been shut down and likely will remain down for a long time. Because of the uncertainty over which plants might still be operable long term, capacity estimates for lime are considered meaningless.

About 75% of currently operating plants are throught to be fueled by coal, whose cost increased little in 1982 and may not increase much this year either. Further conversion to coal seems likely in plants now shut down as a way to boost competitiveness if restarted.

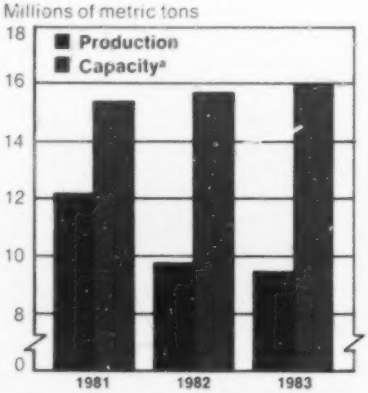
Even with such economies and slowing rising levels of plant use, lime faces another difficult year. Its only market area with basic growth is stack gas scrubbing, and its biggest use in steel faces a shaky future.

S

Sulfur

- ***Demand down***
- ***Capacity inching up***
- ***Prices lowered***

PRODUCTION/CAPACITY



a All sources as of first quarter, exclude standby capacity of about 5 million metric tons at recovery plants and smelters.

HOW MADE

Melted from underground deposits; recovered from sulfur compounds processed in refineries, natural gas processing plants, and smelters

MAJOR DERIVATIVES (U.S.)

Sulfuric acid 90%, chemicals 5%

MAJOR END USES (U.S.)

Fertilizer 60%, chemicals 20%

FOREIGN TRADE

Exports—down slightly to 850,000 tons in 1983, imports—down to about 1.7 million tons

PRICES

List price at Tampa, Fla., $132 per ton; discounts offered in addition

COMMERCIAL VALUE

$1.1 billion for production, 1983

Sulfur was quite late joining the U.S. business slump of the past three years, and it will again be way behind the rest of the chemical industry in recovering. In fact, sulfur production could drop a bit more in 1983 after a 19% plunge last year.

So the yellow element remains in turmoil. Forced increases in production of by-product sulfur from pollution control units at oil refineries and metals smelters have wreaked havoc for mined (Frasch) sulfur production, which nosedived 34% last year.

The main problem is a suddenly constricted fertilizer business, sulfur's dominant market force. Farmers around the world are having financial problems, and now the U.S. government, in a rescue attempt, temporarily has made things worse for fertilizer suppliers. Sulfur will be one of the chemical raw materials most affected by the government's payment-in-kind (PIK) program designed eventually to increase farm commodity prices by holding down current crops. Even though sulfur seems a long way from corn, wheat, and cotton and actually never reaches them as such, its derivative chain through sulfuric acid and phosphate fertilizer hangs mostly on these crops.

Since fertilizer exports also have suffered, analysts see dim prospects for a full recovery in sulfur demand in 1983. The most optimistic view calls for sulfur production to match 1982 at 9.8 million metric tons, counting all forms of production—Frasch, recovered, smelter acid, pyrites, and other. Pessimists don't see it that way and look for much lower production of about 9 million metric tons, especially if forecasts for sulfur imports prove too low.

All these forecasts have many chances to err, both camps admit. Besides the difficulty in estimating the net of imports over exports (both large), this year the economic recovery could further upset forecasts. For example, if industrial demand for sulfuric acid proves higher than expected and fertilizer inventories begin building later in 1983 in anticipation of better farm income, then sulfur production could be much higher. Strong recovery also could upset forecasts for relatively low smelter acid production of sulfur or sulfuric acid, should demand for copper and zinc rise rapidly because of depleted inventories.

Offsetting these brighter possibilities are contrasting factors, such as higher interest rates that might dampen fertilizer inventories, greater foreign competition for export fertilizer sales intensified by the strong dollar, and less than favorable final results in the PIK program.

The midrange view is that 1983 sulfur production could drop 500,000 tons or more below 1982. Monthly data from the Bureau of Mines for Frasch and recovered sulfur production (but not including other forms, which account for about an eighth of the total) are running 10% behind 1982 for the first four months of 1983. Making up this slump during the rest of 1983 may not be possible.

Should sulfur production fail to turn up in 1983, recovered sulfur production again might exceed Frasch production. In 1982, recovered sulfur exceeded Frasch production for the first time, taking 45% of the total, compared to 43% for Frasch. Even if recovered sulfur doesn't actually exceed Frasch in 1983, the longer-term trend will be for recovered sulfur to dominate production because it must be produced whether the market needs it or not. Almost all sulfur in the recovered category comes from oil refining and natural gas processing. Since crude oil is averaging a higher and higher sulfur content, recovery operations at refiners will continue to grow at the expense of Frasch sulfur, now considered as swing production.

Sulfur capacity is still growing, mainly in the recovered area. For example, new recovery units capable of producing 1000 tons a day of sulfur are coming on stream in the recently developed Overthrust Belt gas fields in Wyoming. Although these plants may not run at capacity for some time because of less than anticipated demand for the natural gas, they have the potential of adding large quantities to U.S. sulfur supply in the next few years.

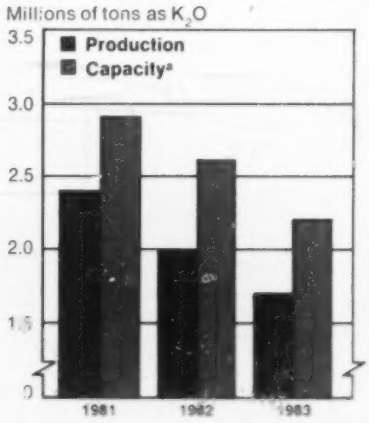
This additional capacity to produce sulfur continues to pressure prices, which have trended down this year. Financial relief is nowhere in sight, and sulfur's total value is due to yet another pasting, down about 25% from its 1981 peak.

Potash

KCl, K_2SO_4, $K_2SO_4 \cdot 2MgSO_4$

- ***Demand way down***
- ***Capacity slashed***
- ***Prices flat***

PRODUCTION/CAPACITY



a First quarter

HOW MADE

Shaft and solution mining of [illegible] potassium salts, [illegible] chloride, and subsequent purification

MAJOR END USES (U.S.)

Fertilizer 95%

FOREIGN TRADE

Exports—holding at about 400,000 tons in 1983, imports—rising to about 5.3 million tons

PRICES

$110 to $130 per ton of K_2O equivalent

COMMERCIAL VALUE

$200 million for production, 1983

The U.S. potash industry has fallen badly in the past three years and is now the most troubled of the major mineral-based inorganics. The industry this year will be down to half size compared to its heyday in the mid-1960s. Canadian imports, which used to split the market, now command as much as 80% of it. U.S. exports are slumping, and U.S. capacity is fast shutting down. Altogether a very grim picture.

Unless something quite unexpected happens to pep up fertilizer use this fall, U.S. potash production will drop another 15% in 1983 to 1.7 million tons (measured as K_2O). This comes after a 17% decline in 1982 to 2.0 million tons. So potash is ailing at close to about one third under its steady output rate of about 2.5 million tons through the 1970s.

Actual U.S. potash demand this year may be about 6.5 million tons, down a bit. Obviously, imports are swelling and take care of most U.S. needs. Imports in 1982 supplied more than 70% of U.S. consumption, according to Bureau of Mines estimates, up from around 65% in 1981 and earlier years. This year, imports of perhaps 5.3 million tons may fill up to 80% of demand.

About a quarter of U.S. potash production will be exported in 1983. On its face, this looks odd in view of Canadian export strength. The explanation comes in transportation costs. Much of the U.S. farm belt can be served with less expensive freight from Canada than from U.S. potash production areas, mainly New Mexico. But potash from New Mexico does have a freight advantage to other areas, for example South American countries.

Even so, U.S. exports fell more than half in 1982 and are expected to remain at about that level, around 400,000 tons. Behind the decline are both debt problems in countries buying large quantities of U.S. potash in the past and relatively high prices resulting from the strong dollar.

U.S. potash fertilizer use declined in 1982 and is expected to be down a bit more in 1983 as a result of reduced acreage under the government's payment-in-kind (PIK) program. Because of this, combined with declining farm income and slumping exports, inventories rose roughly 40% in 1982 even with reduced production. These inventories, although somewhat reduced in early 1983, overhang the market now, keeping prices down and lowering production.

For the first four months of 1983, potash production declined about 17% from a year ago. A lower rate of decline is anticipated later in 1983 as inventories reach acceptable levels and possibly rebuild in advance of the 1984 planting season. Some improvement in production of potash could result from higher fall fertilization if farmers perceive beneficial effects from the PIK program.

If potash production reaches 1.7 million tons in 1983, existing nameplate capacity of about 2.2 million tons will run about 77%. This operating level probably will make a financial breakeven situation for most producers. Some producers who recover potash from western brines could have economic problems as a result of dilution from the heavy runoff after the large snow melt this year.

Another year of low or no profitability could lead to more U.S. mine and plant shutdowns, especially in the face of growing Canadian capacity and the slump in export markets. Alternatively, some facilities might be temporarily shut down over the next couple of years but not actually scrapped. They might be kept in operable condition and put back in production if demand recovers intermittently. Bookkeeping and taxes could help determine the outcome. Since early 1981, U.S. potash capacity has sunk 700,000 tons per year, or 24%, from its old total of 2.9 million tons.

An eventual upturn in U.S. potash will have to come in 1984 or later, depending on whether the PIK program is continued next year. If farm income does rise significantly this year, then sales of all kinds of fertilizer could be up in 1984. Potash might even be slightly stronger because farmers may feel that their reduced use of potash over the past four years has left soil potassium content too low. But all such talk is purely speculative for now.

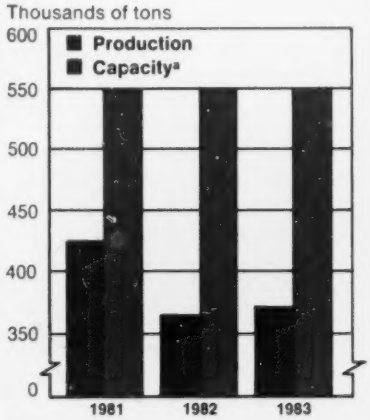
The other uses of potash, mainly to make potassium chemicals, show no upturn of any significance. And in any case, because they are so small, the nonfertilizer uses have a negligible effect on production.

Phosphorus

P_4

- ***Demand depressed***
- ***Capacity may slip***
- ***Prices steady***

PRODUCTION/CAPACITY



a First quarter.

HOW MADE

Reduction of phosphate rock in electric furnaces with carbon (coke) and silica as aids

MAJOR DERIVATIVES (U.S.)

Phosphoric acid and derivatives 85%

MAJOR END USES (U.S.)

Detergents 60%, foods and beverages 15%, metal treatment 10%, chemicals 10%

FOREIGN TRADE

Exports—down to about 10,000 tons in 1983, imports—negligible

PRICES

90 cents to $1.00 per lb at plants

COMMERCIAL VALUE

$700 million for production, 1983

This will not be a recovery year for phosphorus, which analysts predict will stay mired at about its 1982 recessionary pace. That's a disappointment for phosphorus producers, who had stabilized this product in the late 1970s after an earlier decline due to reformulations in its most important market, detergents. The way it now looks, U.S. phosphorus output this year will be about 40% below its all-time peak in 1970.

Phosphorus had a difficult first quarter this year and may show an output decline for the first half. Production has been held down to cut inventories in the face of weak demand. Even with a moderately strong second half, full-year production will do well to be up at all, perhaps 2%.

Estimates for 1983 phosphorus production range from 360,000 to 375,000 tons, quite close to 1982 production of about 365,000 tons. Even with a better than expected second half this year and a steady gain in 1984, production won't make it back to the 1981 level. And a new record above 1970 is out of the question.

Current capacity, including some shutdown, totals some 550,000 tons per year. In 1983, the operating rate will be 67% if production picks up a bit, roughly the same as in 1982. Capacity has held steady for a number of years, with no significant additions in more than a decade. Shutdowns and scrappages also have been minor. For the future, no real changes in capacity are expected other than possible scrapping of some small units now shut down.

Investment money for new phosphorus units hasn't materialized, in part because there is little room to raise prices of on-site derivatives, which take most phosphorus production. Another investment curb is that electric furnaces are very expensive, and producers and engineering companies don't have any recent experience in estimating costs of phosphorus plant projects. Then, too, possible competition from highly purified wet-process phosphoric acid in making many of the same derivatives is a potential threat to new elemental phosphorus investment.

This year, phosphorus plants in the Northwest might do well because the large snow melt this spring favors low-cost hydroelectric power. In contrast, Florida phosphorus plants are shut down because of higher power costs.

But even with favorable power costs for some phosphorus plants, demand has just begun to pick up in the general economic recovery. The first slug of the demand increase was met with inventories, completing a drawdown that began early in 1982. Renewed inventory building, if any, has been cautious.

Demand improvement in the detergent area will continue to follow the economy. This 60% segment of U.S. phosphorus use includes many applications, the largest being home laundry detergents; other applications include the many specialized industrial and commercial cleaners. Detergent demand has an apparent connection to industrial output; when industry picks up, people work more, and work clothes take a lot of detergent to clean. Detergent demand likely will be up enough in 1983 to cover both an export drop of as much as 5000 tons and some decline in making chemical derivatives.

Phosphorus-derived detergent phosphates are no longer plagued by regional phosphate bans in the U.S., which cut deeply into this market in the 1970s. However, continual reformulation in detergents can always drop phosphate levels.

About the only other significant use category expected to be up in 1983 will be food and beverages. Analysts forecast additional phosphoric acid demand in this market resulting from the introduction of more noncaffeine and other soft drinks, partly because of inventory needs.

Most other industrial and agricultural uses still will be down in 1983. For example, metal finishing applications such as aluminum polishing and phosphate coatings on steel are heavily dependent on the automobile industry, now recovering well on a unit-volume basis but not yet very strongly on a materials volume basis because of the earlier shift to smaller cars and light trucks. As with sulfur and potash, the government's payment-in-kind program could hold down sales of agricultural pesticides made from phosphorus intermediates. Most other uses of phosphorus and its derivatives are small, so even major changes would have only a minor effect on total demand.